

Testing a self-determination theory-based teaching style intervention in the exercise domain

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Running head: SELF-DETERMINATION THEORY AND EXERCISE

Testing a self-determination theory-based teaching style intervention in the exercise domain

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Abstract

Drawing from self-determination theory (SDT), this study examined the effect of an autonomy supportive, well structured and interpersonally involving teaching style on exercise class participants' psychological need satisfaction, motivational regulations, exercise behaviour, behavioural intention and affect. Female exercise class participants enrolled in a 10-week exercise program were exposed to a SDT-based (i.e., SDTc; $n = 25$) or typical (i.e., control group; $n = 31$) teaching style. The control condition reported a significant decrease in autonomy support, amotivation and behavioural intention over time. In addition, they reported a significant increase in competence and introjected regulation. Compared to the control condition, the SDTc reported a significantly greater linear increase in structure and interpersonal involvement, relatedness and competence need satisfaction and positive affect. Attendance rates were significantly higher in the SDTc. SDT-based social-contextual characteristics and psychological needs predicted autonomous regulations; all these variables collectively predicted adaptive outcomes.

Key words: Autonomy support, structure, interpersonal involvement, psychological need satisfaction, motivational regulations, exercise promotion.

Testing a self-determination theory-based teaching style intervention in the exercise domain

Although regular physical activity is conducive to physical and psychological health (Biddle & Mutrie, 2001), less than 30% of adults meet current physical activity recommendations (e.g., Department of Health, 2004). To increase the number of people that engage in, and maintain, a physically active lifestyle, the social psychological factors conducive to exercise adoption and adherence need to be delineated. Self-Determination Theory (SDT; Deci & Ryan, 1985), a contemporary theoretical perspective of human motivation, appears to hold promise for elucidating the socio-contextual and psychological factors influencing participation in physical activity.

Basic psychological need satisfaction and a motivational continuum

SDT assumes that all humans possess three basic psychological needs that are fundamental to the nature and quality of engagement in any given domain (Deci & Ryan, 1985), a proposition supported by previous research (e.g., Sheldon, et al., 2001). A need for autonomy reflects a desire to engage in activities of one's choosing and to be the origin of one's own behaviour (deCharms, 1968; Deci & Ryan, 1985). A need for relatedness involves feeling connected to others, or feeling that one belongs in a given social milieu (Baumeister & Leary, 1995; Deci & Ryan, 1985). Finally, a need for competence implies that individuals have a desire to interact effectively with the environment, to experience a sense of effectance in producing desired outcomes and preventing undesired events (Deci & Ryan, 1985).

SDT also proposes three categories of motivation: amotivation, extrinsic motivation, (which is itself made up of four different types of regulation: external, introjected, identified and integrated), and intrinsic motivation. Each type of motivation varies with regard to the amount of autonomy associated with it, and thus, lies along a continuum ranging from low to high self-determination (Deci & Ryan 1985).

1 *Amotivation* represents “a state lacking of any intention to engage in a given
 2 behaviour” (Deci & Ryan, 1985; Markland & Tobin, 2004a). With *external regulation*, an
 3 individual engages in an activity to obtain external rewards or to avoid punishments (Deci &
 4 Ryan, 1985). Individuals guided by *introjected regulation* engage in the activity because of
 5 internal pressure, feelings of guilt or to attain ego enhancement (Ryan & Deci, 2000).
 6 *Identified regulation* reflects participation in an activity because one holds certain outcomes
 7 of the behaviour to be personally significant (e.g., improved health). *Integrated regulation*
 8 occurs when identified regulations are fully assimilated into the self and are brought into
 9 congruence with one’s other values and needs (Deci & Ryan, 2000). *Intrinsic motivation*
 10 involves partaking in an activity because it is inherently enjoyable (Deci & Ryan 2000).

11 SDT posits that satisfaction of the basic psychological needs is central to determining
 12 the type of regulation guiding behaviour (Deci & Ryan, 2000). Satisfaction of the needs of
 13 autonomy and competence are proposed as central to promoting intrinsic motivation. If
 14 autonomous forms of extrinsic motivation (i.e., integrated and identified regulation) are to
 15 guide behaviour, the needs of autonomy and relatedness must be satisfied. However, when
 16 the needs are pitted against one another, or are thwarted, more controlling forms of
 17 motivational regulation (i.e., introjected and external regulations) or amotivation ensue (Deci
 18 & Ryan, 1985, 2000; Koestner & Losier, 2000). When the psychological needs are satisfied
 19 and more autonomous forms of regulation guide behaviour, adaptive behavioural, cognitive
 20 and affective responses are expected (Deci & Ryan, 1985; Vallerand, 1997). In contrast, need
 21 thwarting and less autonomous forms of regulation are proposed to result in non-optimal
 22 outcomes (Ryan & Deci, 2000).

23 *Facilitating psychological need satisfaction, autonomous motivation and adaptive outcomes*

24 SDT may be considered a particularly attractive theory for health and exercise
 25 professionals attempting to facilitate health behaviour change, as it specifies three socio-

contextual variables (i.e., autonomy support, structure and interpersonal involvement) which are held to correspond to variability in psychological need satisfaction, the motivational regulations undergirding behaviour and ensuing motivational outcomes.

Autonomy support refers to the provision of choice and meaningful rationale from those in a position of authority, acknowledgment of the perspective of others, and minimization of pressure (Deci, Eghrari, Patrick & Leone, 1994). For example, an exercise instructor who is behaving in an autonomy supportive manner will see the situation from the exercisers' perspective, and encourage them to make their own decisions. He/she would not attempt to impose his/her own perspective on them, or attempt to make them change (Williams, Gagne, Ryan & Deci, 2002). When at least two of the components of autonomy support are present, it is postulated that the regulation of behaviour will be accepted by the exerciser as their own, and the most autonomous forms of external regulation will guide their behaviour. If only one or none of these factors are present, partial internalization will occur and less autonomous forms of regulation will arise (Deci et al., 1994).

Structure describes the extent to which behaviour-outcome contingencies are made understandable, and whether those in a position of authority make their expectations clear and provide feedback (Deci et al., 1994; Deci & Ryan, 1991; Reeve, 2002; Ryan, 1993). Thus, to provide structure, an exercise instructor would set clear goals at the start of the class. To facilitate autonomous regulation, the components of structure should be delivered in an autonomy supportive manner (Deci & Ryan, 1991). For example, in the case of an exercise class, it would be best for the instructor to involve class participants in the goal setting process.

Finally, *interpersonal involvement* refers to the quality of the relationship between those in a position of authority and the individuals they interact with, and represents the formers' willingness to dedicate psychological resources, such as time, energy, and affection

(Deci & Ryan, 1991; Reeve, 2002). In an exercise class, the instructor would demonstrate interpersonal involvement by recognizing participants' interest and disinterest, and if a problem arose, trying to counter the difficulty and re-engage the class. To derive advantageous outcomes, interpersonal involvement must be also be delivered in an autonomy supportive manner; that is, the authority figure should provide unconditional positive regard which is non-contingent and non-judgmental (Deci & Ryan, 1991).

Previous research examining the socio-contextual characteristics advanced by SDT

Perceived autonomy support has been shown to be positively related to psychological need satisfaction, autonomous regulation and/or adaptive behavioural, cognitive and affective outcomes in the educational (e.g., Reeve, 2002; Reeve et al., 2004; Vansteenkiste, Simons, Lens, Sheldon, and Deci, 2004a), health care (e.g., Williams, McGregor, Zeldman, Freedman, & Deci, 2004; Williams, Grow, Freedman, Ryan, & Deci, 1996; Kennedy, Goggin, & Nollen, 2004; Williams, Rodin, Ryan, Grolnick, & Deci, 1998) and exercise (e.g., Edmunds, Ntoumanis, & Duda, 2006; Wilson & Rodgers, 2004) domains. Research has also demonstrated that it is possible for teachers to learn how to become more autonomy supportive with students (Reeve, 1998; Reeve, Jang, Carrell, Jeon, & Barch, 2004), and experimental studies have revealed that an autonomy supportive interpersonal counseling or teaching style can predict adaptive motivational and behavioural outcomes in health care (e.g., smoking cessation; Williams et al., 2002, 2006) and exercise (e.g., Vansteenkiste, Simons, Soenens, and Lens, 2004b) settings.

To our knowledge however, previous SDT-focused studies have only considered the potential advantage of an autonomy supportive interpersonal climate; the socio-contextual characteristics of structure and interpersonal involvement have yet to be considered. Further, studies have examined the effect of autonomy support on only one need [e.g., competence (Williams et al. 2002, 2006) or autonomy (e.g., Vansteenkiste et al. 2004b)], or have used, in

the majority of instances, an autonomous motivation composite (Vansteenkiste et al. 2004a; Williams et al. 2002, 2006). Research has yet to delineate the impact of a SDT-based social climate, which incorporates the dimensions of autonomy support, structure and interpersonal involvement, on the satisfaction of the three psychological needs and each of the motivational regulations encompassed within SDT.

Aims and hypotheses of this study

The first objective of the present study was to examine whether an exercise instructor's teaching style can be manipulated so that it is perceived by exercise class participants and independent observers as providing more autonomy support, structure and interpersonal involvement. Given that autonomy support has been defined as a mode of communication that is context free, and research in the educational domain has shown that teachers can be taught how to be autonomy supportive (e.g., Reeve, 1998; Reeve et al, 2004; Williams, et al, 2002, 2006), it was hypothesized that over time an autonomy supportive, as well as a well-structured and interpersonally involved, teaching style (i.e., SDT-focused condition; SDTc) would be rated by exercise class participants and independent observers as providing higher levels of autonomy support, structure and interpersonal involvement, compared to a control condition/ standard practice exercise class environment.

The second objective was to examine impact of an exercise class taught in accordance with the socio-contextual variables advanced by SDT on the psychological needs, autonomous motivation, and related outcomes. Based on the literature (e.g., Edmunds et al., 2006; Mageu and Vallerand, 2003), it was also hypothesized that, compared to participants in the control group, those in the SDTc would report significant increases in psychological need satisfaction and self-determined motivation over time. As psychological need satisfaction and autonomous regulation are held to promote adaptive outcomes (Deci & Ryan, 1985), it was

also expected that the SDTc would also facilitate significant increases in exercise related behavioural engagement and positive affect.

The third objective was to examine the motivational sequence embedded in SDT. Specifically, we hypothesized that autonomy support, structure and interpersonal involvement would predict psychological need satisfaction. In conjunction with the social-contextual variables, psychological need satisfaction was hypothesized to positively predict autonomous regulation, and negatively predict more controlling forms of regulation. Finally, social-contextual characteristics, psychological need satisfaction and autonomous regulations were hypothesized to predict adaptive behavioural, cognitive and affective outcomes. Controlling regulations were expected to result in less desirable consequences.

Method

Participants

Participants were female university students and staff who had signed up for one of two exercise classes conducted in the university sports center (no men signed up for, or engaged in, either class). As participants paid for their class, they chose the class in which they participated. One class was randomly designated as the SDTc, whilst the other formed the control condition. Twenty five females were in the SDTc. These women ranged from 18 – 53 years of age ($M = 21.26$, $SD = 3.80$). The control group included 31 females, who ranged in age from 18 – 38 years ($M = 21.36$, $SD = 6.71$). The two groups did not significantly differ in age ($t(54) = .07$, $p = .94$). The majority of participants in the SDTc classified themselves as White (96%; 4% as Chinese). In the control group, 74% of participants classified themselves as White, 19.3% as Asian/Asian British (i.e., Indian, Pakistani, Bangladeshi, or any other Asian background) and 6.5% as Chinese. Chi square analysis, based upon Fisher's exact probability test (utilized because 50% of cells had expected cell counts less than 5), revealed a significant difference ($p = .03$) between the groups in terms of their ethnic/racial

composition (i.e., White versus Non-White). Ninety six percent of participants in the SDTc, and 90% in the control group, were university students.

Procedures

This study was approved by the ethics subcommittee of a large UK University. Two intermediate level “cardio combo” (i.e., a mix of boxing choreography and step aerobics) classes constituted the mode of exercise in the current study. Classes were held on a Monday (SDTc) and Wednesday (control) evening, once a week, for 10 weeks. Both classes were run by the same exercise instructor (i.e., a 28 year old White Canadian female, certified by the Canadian Association of Fitness Professionals, with 11 years of teaching experience), in the same venue, throughout the same academic term (i.e., October – December), and at a similar time of the day (i.e., both classes were held in the early evening). As in previous studies of SDT-based interventions in the health care domain (i.e., smoking cessation; Williams et al., 2002), we decided that we would have one exercise instructor delivering both conditions as this would take into account individual differences in treatment styles.

Week one class constituted a ‘taster’ session, whereby individuals could try out the exercise class before signing up and paying for the duration of the term. The social-contextual characteristics were not manipulated in this week; the instructor exhibited her typical teaching style. At the end of this first session, the principle investigator informed participants that their class had been selected to take part in a study being conducted at the University. Upon stressing that participation was voluntary, participants were informed that the study aimed to examine personal and psychological characteristics of the exerciser and exercise class leader which can influence the exercise experience. Participants in the SDTc were not informed that the leadership style exhibited in their class was manipulated, and neither class were they told that they would be compared to another class/condition. To act as

1 an incentive, class members were informed that if they agreed to participate and provided all
2 required data, they would be entered into a £50 (approximately \$90 US) prize draw.

3 Those participants that decided to sign up to the class for the duration of the term, and
4 who were willing to take part in the study, provided informed consent (observations of the
5 classes would suggest that this was approximately 70% of members of each class). They also
6 completed an initial questionnaire packet measuring basic demographic variables, perceived
7 autonomy support, structure and interpersonal involvement provided by the exercise
8 instructor, psychological need satisfaction, motivational regulations, behavioral intention, and
9 positive and negative affect (see *Measures* for details). In addition, two trained, independent
10 observers, blind to the experimental conditions, rated the level of autonomy support, structure
11 and interpersonal involvement provided by the exercise instructor in week 1. Moreover, the
12 independent observers also rated the ‘active engagement’ demonstrated by participants in
13 each condition (i.e., the behavioural intensity and emotional quality of participants’
14 involvement in the class; Reeve et al., 2004).

15 From week 2 to the end of the study the exercise class leader manipulated her
16 teaching behaviour to fit the regulatory style selected for each group. In creating the SDTc,
17 the exercise instructor focused upon promoting autonomy support by taking the perspective
18 of the exercise class participants into account, acknowledging their feelings and providing
19 them with pertinent information and opportunities for choice (Deci et al., 1994). Participants
20 in the SDTc were given choice regarding which exercises they wanted to do. These exercises
21 were then replicated in the control condition so that members of the two classes received
22 comparable physical work-outs, reducing the likelihood that class differences in outcome
23 variables could be attributed to differences in physical workload. The use of pressure,
24 demands and extrinsic rewards were also minimized (Black & Deci, 2000; Reeve et al.,
25 2004). Structure was established by providing clear expectations, optimal challenge and

timely and informative feedback (Reeve, 2002; Reeve et al, 2004). The exercise instructor dedicated psychological resources to the participants, showing that she was interested in them, and that she was concerned about their well-being (Reeve, 2002; Reeve et al, 2004). The control group was intended to replicate the style of teaching regularly observed in the exercise setting. Although autonomy support, structure and interpersonal involvement were not intentionally promoted in this group, no attempts were made to purposefully undermine participants' experiences in this condition.

The same measures of autonomy support, structure and interpersonal involvement completed during week 1, were also rated by participants in weeks 5 and 9. In addition, during weeks 4 and 8, the same independent observers as those utilized in week 1 rated the autonomy support, structure and interpersonal involvement provided by the exercise class leader, and the amount of "active engagement" displayed by the exercise class participants. These measures tested the extent to which the desired social-contextual characteristics were effectively manipulated in the SDTc, versus, control condition. In weeks 6 and 10, the same measures of psychological need satisfaction, motivational regulations, behavioral intention, and affect, as those provided during week 1, were completed by the participants.

When all measures were collected, participants were debriefed about the purposes of the study and their questions answered. We recognized that it was possible for participants in the two conditions to have known one another, and that they could have discussed their participation or guessed the nature of the study. Thus, the principle investigator also asked participants whether they had discussed their study involvement with participants of other exercise classes or guessed the actual purpose of the study. No participants reported doing so.

Measures

Socio-contextual characteristics. Exercise class participants' perceptions of autonomy support, structure and interpersonal involvement were assessed using the Perceived

Environmental Supportiveness Scale (Markland & Tobin, 2004b). Markland and Tobin have shown these subscales to be internally reliable (Cronbach alpha values were .79, .79 and .78, respectively). In addition, independent observers completed an adapted version of an observation rating scale developed by Reeve et al. (2004) to measure autonomy support, structure and interpersonal involvement provided by the exercise instructor, and the active engagement displayed by exercise class participants. Reeve et al. have shown these subscales to possess adequate reliability (i.e., α 's >.81).

Psychological need satisfaction. Autonomy, relatedness, and competence were measured via the Psychological Need Satisfaction Scale (Markland & Tobin, 2004b). Markland and Tobin have reported Cronbach alpha values of .59, .72 and .69, respectively, for these subscales.

Motivational regulations for exercise. Participants' motivation to engage in the exercise class was measured using the Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004a). Cronbach alphas for all BREQ-2 subscales have been shown to exceed .75 (Wilson & Rodgers, 2004). The present study also utilized the integrated regulation of Li's (1999) Exercise Motivation Scale. This scale has also been shown to display adequate internal reliability in past work (i.e., α 's >.75; Li, 1999).

Exercise behaviour. Adherence to the exercise class was measured via a weekly register of attendance, completed by the exercise instructor for each condition.

Behavioural intention. Behavioural intention to continue participating in the exercise class was assessed using a methodology reported by Wilson and Rodgers (2004). During weeks 1 and 6 this measure assessed participants' intention to continue exercising in their current exercise class. At week 10 (the end of the course), items were worded to assess whether participants intended to join exercise classes run by their present exercise class

leader during the following term. Wilson and Rodgers reported an internal consistency of $\alpha = .89$ for this scale.

Positive and negative affect. The Positive Affect and Negative Affect Scale (PANAS; Watson, Tellegen, & Clark, 1988) was used to measure the positive and negative affect that participants felt while exercising in their class. Watson and colleagues (1988) showed the scale to possess acceptable internal consistencies (i.e., α 's ranged from .86 to .90), good test-retest reliability, and factorial and convergent validity.

Results

Reliability analyses and descriptive statistics

Internal consistency estimates and descriptive statistics were computed for all variables at each measurement point for both groups (see Tables 1 & 2). For each questionnaire completed by the exercise class participants, internal consistency coefficients were calculated. In most cases, observed Cronbach alpha's were greater than .70. Bivariate correlations were also computed to assess the reliability of the independent observer ratings, for each variable (i.e., autonomy support, structure, interpersonal involvement and active engagement), across the three measurement occasions, in both conditions. Bivariate correlations ranged from .60 to .99, with the exception of one (i.e., $r = .33$; Mean $r = .78$). However, these correlations should be interpreted with caution as they are based on 2 degrees of freedom only.

At week 1, autonomy support was the socio-contextual characteristic perceived most highly by participants in both conditions, followed by structure and then interpersonal involvement. The independent observers rated structure most highly during week 1. Autonomy was the psychological need, and intrinsic motivation the motivational regulation, rated most highly by participants in both conditions in week 1. In general, the mean scores for the socio-contextual variables, psychological needs and autonomous forms of regulation, as

well as the outcomes of interest (e.g., positive and negative affect), remained constant or decreased over time for the control group, whereas they increased in the SDTc. The statistical significance of these changes was explored via multilevel analysis.

Multilevel regression analyses

Multilevel regression modeling (MLM), using MLwin (version 2.0; Rasbash et al., 2005), was used to test the main hypotheses. As with standard regression analyses, the aim of MLM is to express the dependent variable as a function of predictor variables. However, the multilevel regression equations specified in this study incorporated two levels of analyses: A within-person equation (or Level 1 model), which is concerned with within-individual change (i.e., how each individual changes over time), and a between-person equation (or Level 2 model), which is concerned with inter-individual differences in change (i.e., what predicts differences between people in their rate of change). MLM is particularly useful for the analysis of longitudinal data in which there are several measurements nested within individuals. In this study, the data set was comprised of three weekly observations (weeks 1, 5 and 9 for the ratings of autonomy support, structure and interpersonal involvement, and weeks 1, 6 and 10 for all other study variables), nested within study participants. MLM is also suitable when there are missing data (i.e., participants not completing all assessments), as was the case in the present study (see Singer & Willet, 2003 for more information).

Is it possible to manipulate the socio-contextual variables proposed by SDT?

First, we tested conditional growth models examining the effects of the teaching style condition (a dichotomous variable was created, where control = 0 and SDTc = 1) on the intercept and rate of change (i.e., slope) of each social-contextual variable proposed by SDT. In these models, the intercept reflects the level of the dependent variable (e.g., autonomy support) at baseline (the time measure was centered around the baseline) for the control group, whereas the main effect for condition represents the difference in the baseline scores

between the two conditions. The slope represents the change in the dependent variables scores in the control group, whereas the interaction between the slope and condition shows the difference in the rate of change of scores between the control and the SDTc over the course of the 10-week program.

The SDTc and control group did not differ in baseline levels of the socio-contextual variables. In the control group, autonomy support ($B = -0.65, p < .001$) demonstrated a significant linear decrease over time. The SDTc differed significantly to the control group in autonomy support ($B = 1.25, p < .001$), structure ($B = 0.56, p < .05$), and interpersonal involvement ($B = 0.49, p < .05$); each demonstrated a significant linear increase over time.

Assessing the impact of a SDT-based social context on psychological need satisfaction, the motivational regulations and related exercise outcomes.

In line with the models presented above, we then tested conditional growth models examining the effects of the teaching style on the intercept and rate of change (i.e., slope) of each psychological need, motivational regulation and exercise related outcome.

Psychological needs. Baseline means for autonomy, relatedness, and competence need satisfaction for participants in the SDTc were not significantly different to those in the control group. Competence need satisfaction was the only psychological need to demonstrate a significant change over time in the control group ($B = 0.32, p < .05$). Compared to the participants in the control group, participants in the SDTc displayed a significantly greater linear increase in relatedness ($B = 0.50, p < .05$) and competence ($B = 0.66, p < .01$) need satisfaction. It is important to note that, although non-significant, an inspection of the mean scores revealed that autonomy increased from baseline to weeks 6 and 10 in the SDTc. Moreover, a positive beta weight was observed for autonomy in the SDTc, compared to a negative beta weight for the control group.

Motivational regulations. Baseline scores for participants in the SDTc differed significantly to those in the control group for intrinsic motivation ($B = -0.47, p < .01$), and identified ($B = -0.39, p < .05$) and introjected ($B = 0.46, p < .05$) regulations. Participants in the SDTc started the intervention with lower levels of autonomous motivation (i.e., intrinsic motivation and identified regulation) and higher levels of introjected regulation. For those in the control group, introjected regulation demonstrated a significant linear increase over time ($B = 0.29, p < .01$), whereas amotivation showed a significant linear decrease ($B = -0.22, p < .001$). The SDTc did not differ to the control group in terms of the rate of change observed for any of the motivational regulations; although the betas for the rate of change in integrated regulation and identified regulation were positive in the SDTc and negative in the control condition, and the difference between the SDTc and control group in the rate of change of identified regulation did approach significance ($B = 0.21, p = .06$).

Behavioural, cognitive and affective outcomes: Participants in the SDTc started the exercise program with significantly lower levels of positive affect derived from exercise ($B = -0.34, p < .05$). In the control group, behavioural intention ($B = -0.77, p < .001$) decreased over time¹. The SDTc demonstrated a significantly higher and positive slope for positive affect ($B = 0.25, p < .01$).

Differences in attendance. An independent samples t-test revealed a significant difference between groups in attendance ($t(54) = -2.04, p < .05$), with participants in the SDTc ($M = 6.52, SD = 2.66$) attending significantly more often than those in the control condition ($M = 5.19, SD = 2.21$). This difference was calculated to reflect a medium effect size ($d = 0.54$).

Examining the motivational sequence of SDT

A final group of models examined the main effects of key demographic and psychological predictors on each need, regulation and outcome. These models also examined

whether the effects of these predictor variables varied over time. Even if the effect of “condition” was not significant for a particular study variable in the original models, we retained “condition” in these final models, as it constitutes the major independent variable in the current study. Thus, we felt it was important to control for its effect.

Predicting the socio-contextual variables. Ethnicity and age did not play a role in predicting any of the social contextual characteristics advanced by SDT (Note: ethnicity and age did not emerge as significant predictors in any of the subsequent models, and thus, shall not be discussed further).

Predicting the psychological needs: The social-contextual dimensions were added simultaneously as predictors of each psychological need. However, the results of the multilevel regression analyses, when compared with data derived from simple correlation analyses, suggested that the model for competence need satisfaction was marked by net suppression (Cohen & Cohen, 1983). Net suppression occurs when a correlation between two independent variables suppresses the real effect of each variable on the criterion variable under examination, and consequently, regression coefficients are reduced or emerge in the opposite direction to that indicated by correlation coefficients. Net suppression effects are common in the testing of complex models (Cohen & Cohen, 1983). To test for suppression effects, each variable (i.e., autonomy support, structure, and interpersonal involvement) was modeled separately as a predictor of competence need satisfaction. The problematic B 's emerged in the opposite direction to that observed in the original model, and thus, net suppression was confirmed. Thus, in interpreting the model for competence need satisfaction, we used the B values derived from the three separate models. For autonomy and relatedness, the predictor variables were entered and assessed simultaneously. None of the social-contextual characteristics emerged as significant predictors of any of the psychological needs. Moreover, the effects of these variables did not vary significantly over time.

Predicting the motivational regulations. The social-contextual characteristics and psychological needs were then added as predictors of each of the motivational regulations. We found that the models for external, introjected and integrated regulation were also marked by net suppression. Thus, for external, introjected and integrated each predictor variable was entered into, and assessed, separately the model. For all other motivational regulations, the predictor variables were entered and assessed simultaneously.

Structure ($B = 0.63, p < .05$) and competence ($B = 0.16, p < .01$) emerged as positive predictors of integrated regulation at baseline. Autonomy ($B = -0.39, p < .001$) emerged as a negative predictor of identified regulation at baseline. The effects of autonomy and autonomy support on identified regulation (autonomy $B = 1.06, p < .001$; autonomy support $B = 0.48, p < .01$) and intrinsic motivation (autonomy $B = 0.64, p < .01$; autonomy support $B = 0.62, p < .01$) varied significantly over time. The effect of autonomy on integrated regulation ($B = 1.35, p < .001$) also varied significantly over time. Plotting these interactions revealed that although autonomy need satisfaction was a negative predictor of identified regulation at baseline, it became a significant positive predictor at weeks 6 and 10. For integrated regulation and intrinsic motivation, autonomy was not a significant predictor at baseline, but it became a significant positive predictor at weeks 6 and 10. The effects of autonomy support on intrinsic motivation and identified regulation were positive on all three measurement occasions. Moreover, this effect increased over time.

Predicting cognitive and affective outcomes. The SDT-based social-contextual characteristics, psychological needs and motivational regulations were then examined as predictors of exercise class specific behavioural intentions, and exercise related positive and negative affect. Net suppression effects were identified and confirmed for all outcome variables. Thus, each predictor variable was entered into, and assessed separately, for each model/ outcome variable.

Autonomy support ($B = 0.30, p < .05$), structure ($B = 0.49, p < .05$), and interpersonal involvement ($B = 0.36, p < .05$) positively predicted behavioural intention at baseline, whereas amotivation ($B = -1.06, p < .01$) was a negative predictor. Integrated regulation ($B = 0.30, p < .05$) emerged as a positive predictor of positive affect. Competence ($B = -0.09, p < .05$) negatively predicted, and external regulation ($B = 0.43, p < .01$) and amotivation ($B = 0.26, p < .05$) positively predicted negative affect at baseline. The effects of structure ($B = -0.41, p < .05$), interpersonal involvement ($B = 0.51, p < .05$), intrinsic motivation ($B = 1.08, p < .05$) and amotivation ($B = 0.98, p < .05$) on behavioural intention also varied significantly over the three measurement occasions. Plotting these interactions revealed that structure and interpersonal involvement were significant positive predictors of behavioural intention at baseline, and amotivation was a negative predictor. However, these effects became non-significant on subsequent measurement occasions. Intrinsic motivation did not predict behavioural intention at any time-point, but its effect approached significance at week 10.

Discussion

The present research entailed a manipulation of the autonomy supportive, structural and interpersonal facets of an exercise instructor's teaching style in a real-life exercise setting. We then examined whether the manipulated environment, in contrast to a standard exercise class environment, impacted changes in psychological need satisfaction, autonomous motivation, and behavioural, cognitive and affective exercise outcomes over the course of a 10-week exercise class program. Finally, this study also explored, over time, the inter-relationships between the socio-contextual variables, psychological needs, motivational regulations and exercise related behaviours, cognitions and affect.

Creating an exercise environment based on SDT's propositions

At week 1, the levels of autonomy support, structure and interpersonal involvement reported by participants in the control group and SDTc were not statistically different. This

was expected considering that week 1 constituted a baseline for the study. Thus, the exercise class instructor taught both classes in accordance with her typical teaching style. This finding is desirable considering that random allocation of participants was not possible.

The results also demonstrate that it is possible to train an exercise instructor to create a class environment marked by autonomy support, structure and interpersonal involvement. Support for the effectiveness of the manipulation stemmed from participant self-reports as well as by ratings provided by two independent observers. These findings concur with prior research indicating that teachers, and health professionals, can be effectively trained to adopt a self determination centered teaching style (e.g., Reeve, 1998; Reeve et al., 2004; Williams et al., 2002, 2006). In contrast, perceptions of structure and interpersonal involvement did not change over time in the control group, whereas perceptions of autonomy support decreased. The former results make sense as the teaching style manifested in the control condition was intended to reflect the normal behaviour of the exercise instructor. Although decreasing significantly over time, it is important to note that the mean perceptions of autonomy support remained above average for the duration of the 10 week course among control group participants. Thus, the control condition could not be considered as providing an unrealistically low, or potentially detrimental, level of autonomy support.

Facilitating adaptive motivational processes and outcomes

Besides exploring baseline differences and changes in the three socio-contextual characteristics, we were also interested to examine, in each condition, baseline levels and changes over time in reported psychological need satisfaction, motivational regulations, and behavioural, cognitive and affective outcomes. Participants in the control condition reported no changes in autonomy and relatedness need satisfaction, but demonstrated a significant linear increase in competence need satisfaction over the 10-week course. The former findings support our hypotheses but the latter finding was in contrast to predictions. However, it is

1 plausible that, as long as the exercise tasks are not too complex or demanding, being involved
 2 in an exercise program would increase class participants' feelings of competence over time,
 3 especially for those with a short exercise history.

4 SDTc participants demonstrated a significant linear increase in relatedness and
 5 competence need satisfaction over time when compared to the control group. However, their
 6 reported autonomy need satisfaction did not exhibit a significantly greater rate of change
 7 when contrasted to the responses of those in the control condition. It is possible that the latter
 8 finding is due to the participant recruitment procedures. All participants in the current study
 9 chose to sign up to their exercise class of their own will, and hence, they probably felt
 10 autonomous towards their exercise engagement. This suggestion is supported by the
 11 observation that autonomy was the most highly satisfied need across both conditions and all
 12 measurement occasions (Table 2).

13 There was no difference between the two conditions in terms of the rate of change of
 14 autonomous motivation. However, it is notable that the betas for the rate of change in
 15 autonomous motivational regulations in the SDTc condition were positive, as would be
 16 expected by SDT (Deci & Ryan, 1985), while negative beta weights emerged for the control
 17 group. This trend suggests that a SDT-based teaching style has the potential to enhance the
 18 value exercisers place on exercise engagement.

19 For participants in both conditions, introjected regulation increased, whilst
 20 amotivation decreased, over time. The latter finding makes sense as, in a context in which
 21 attendance is *not* mandatory, it would be unlikely that anyone who was still engaged in the
 22 exercise class (and part of the study) through 10 weeks would be higher in amotivation than
 23 when they started the class. Amotivation is manifested when the participant lacks the
 24 intention for behavioural engagement. In both conditions, as we moved through the 10 week
 25 class, those still involved in the class were by definition behaviourally engaged and most

likely having their participation fueled by more autonomous or controlling reasons. Amotivation is also held to stem from feelings that one is not competent to successfully engage in a particular activity (Ryan & Deci, 2002). Among the present sample of participants, in both classes, perceptions of competence were relatively high.

The observed increase in introjected regulation for SDTc and control group participants is more difficult to explain. It might have been the case that, even when presented with a more self-determination focused class, the ego involvement of the students (perhaps revolving around social pressures regarding one's physique) became more pronounced over the 10 weeks. Previous research has indicated that females tend to be more concerned with appearance-related issues in general (e.g., Pliner, Chaiken & Flett, 1990) and such body image concerns can be heightened in exercise settings (which typically involve a greater exposure of the body due to the clothing required, presence of mirrors, etc.; Martin Ginis, Jung, & Gauvin, 2003). Thus, the female participants in the current study may have used social standards of physique, increasingly so as the exercise program unfolded, to judge their self worth. Ego involvement and contingent other-referenced judgements of self worth are held to be contributors to greater introjection (Deci & Ryan, 2000; Ryan & Brown 2003). It is also important to note that the class sizes in both conditions were moderate. In groups of approximately 30 (or less) led by one instructor over 10 weeks, missing a class would be more noticeable than in exercise programme involving a larger number of participants and multiple instructors. Thus, the observed increase in introjection may have been due to participants feeling more guilty about missing their weekly session as the term progressed.

This study also explored the behavioural, cognitive and affective responses to the leadership styles manifested in the SDTc and control conditions. First, a significant difference in attendance was observed; with those in the SDTc condition attending more regularly than those in the control group. Based on Hunter and Schmidt's (1990) suggestion that effective

psychological interventions usually have an effect size of 0.20 - 0.40, the effect size observed in the current study (i.e., $d = 0.54$) highlights the potential for SDT-focused interventions to impact behavioural engagement in the exercise domain. Second, compared to the control group, participants in the SDTc exhibited a significant increase in positive affect derived whilst exercising over the course of the 10-week exercise program. Taken together, these findings demonstrate that interventions grounded in SDT can enhance exercise adherence and facilitate positive affective exercise experiences.

Contrary to SDT, behavioural intention decreased over time in the SDTc (akin to the control group). It is possible that the different wording of the items used at weeks 1 and 6, which were specific to participation in the 10-week exercise program *per se*, compared to the wording of the items used in week 10, which measured intention to take part in future classes run by the instructor, impacted the results obtained. Supplementary analyses focusing on changes from week 1 to week 6 revealed that those in the control group demonstrated a significant reduction in behavioural intention whilst those in the SDTc did not. In understanding the reduction in intention after week 6 observed in both conditions, we should note that the majority of participants recruited in the current study were students. The decrease in behavioural intention may have reflected a realization of how hard it is to adhere to an exercise program whilst embracing the work (in UK universities, the majority of assessment takes places at the end of term) and social commitments of university life.

Longitudinal relationships between psychological need satisfaction, motivational regulations, and adaptive behavioural, cognitive and affective exercise-related outcomes.

This study also examined the longitudinal relationships between psychological need satisfaction, motivational regulations, and exercise-related outcomes over the course of the 10-week exercise class program. Structure emerged as a significant predictor of competence need satisfaction, a finding which is consistent with Reeve (2002). Also supporting SDT

(Deci & Ryan, 1985; Ryan & Deci, 2002), competence need satisfaction emerged as a negative predictor of negative affect, whereas the least autonomous form of motivation (i.e., external regulation) and amotivation emerged as positive predictors of the same variable. Amotivation was negatively associated with behavioural intention, whereas integrated regulation emerged as a positive predictor of positive affect. In addition, autonomy support, structure and interpersonal involvement were positively linked to behavioural intention.

The beta weights for autonomy support and autonomy need satisfaction became more positive over time in the prediction of the three most self-determined forms of motivational regulation. These findings add credence to Deci and Ryan's (2000) arguments that social contextual characteristics and psychological needs play an important role in facilitating the internalization process (i.e., by becoming more important in the prediction of autonomous regulation over time).

As is the case with any piece of research, the present study was marked by a number of limitations. Firstly, the inclusion of participants from a university setting limits the generalizability of the findings. Future studies involving less educated and/or male exercisers, and/or taking place outside of the University setting are warranted. It also should be noted that study participants were not randomized into conditions (and we did not control for variables such as previous exercise involvement). Perhaps as a consequence, participants in the SDTc were observed to start the study with lower levels of autonomous and higher levels of controlling motivation. Subsequent work would benefit from a cluster randomized design which considers levels of potentially important discriminating variables, such as pre-existing psychological need satisfaction, autonomous motivation for physical activity engagement, and past history regarding exercise involvement, on entry to the programme.

In addition, we were unable to examine the motivational processes underpinning longer-term exercise engagement. This shortcoming could be rectified in the future by

examining whether ‘teaching style’ (i.e., SDT versus control class condition) corresponds to differential participation in exercise classes in subsequent terms. Finally, it is important to emphasize that this study involved only one exercise instructor teaching across two exercise classes. By using the same exercise instructor to deliver both treatment types/ conditions, we were able to control for the personal characteristics of the exercise leader (as advocated by Williams et al., 2002). Manipulation checks confirmed that the environments of the two exercise classes were perceived to be different by class participants. Research is now needed to explore the impact of different instructors, as well as the effect of different class contexts. For example, future work could involve a number of different instructors randomly assigned to a SDT-based training programme or control group (standard practice), and examine the effects of these teaching styles in different exercise settings (University, community, health care) via multi-level analysis. Future work with multiple instructors may also assess the impact of different personality traits on the success of the intervention.

Conclusions

This study represents the first comprehensive experimental test of an SDT-based intervention in a real life setting. The findings suggest that the degree of autonomy-support, structure, and interpersonal involvement provided by exercise leaders can positively influence exercise class participants’ behavioural, cognitive, and affective responses to exercise. Consequently, the present research supports the external validity of SDT’s theoretical framework in relation to exercise (Mook, 1983). The observed interdependencies between the socio-contextual characteristics, psychological needs, motivational regulations and related outcomes were also consonant with the theoretical propositions of SDT (Deci & Ryan, 1985; Koestner & Losier, 2002; Reeve, 2002). Although this research needs to be replicated and expanded, our results should be considered as a first, encouraging step for the application of effective exercise promotion strategies grounded in self-determination theory.

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Footnotes

¹ The measure of behavioural intention used at the third, and final, measurement point (i.e., week 10) was worded differently to that utilized at weeks 1 and 6. During weeks 1 and 6 the items referred to participants' intention to continue participating in the exercise class until the end of the course. However, at the last measurement point the items tapped whether participants intended to join exercise classes run by their instructor in the subsequent term. We recognize that this distinction may have impacted on our findings. Thus, we carried out separate paired samples t-tests focusing on the first two time points only. These tests revealed that from weeks 1 – 6 the control group decreased significantly in their behavioural intention to continue partaking in the exercise group. There was no such decrease in the SDTc group.

Table 1.

Reliability Analyses (Cronbach's Coefficient α) and Descriptive Statistics for the Social-Contextual Characteristics at Weeks 1, 5 and 9, by Condition

			<i>Week 1</i>		<i>Week 5</i>		<i>Week 9</i>			
Variable			C	SDTc	C	SDTc	C	SDTc		
Exercisers' self-reports	Range	α	<i>M</i>	<i>M</i>	α	<i>M</i>	<i>M</i>	α	<i>M</i>	<i>M</i>
			(<i>SD</i>)	(<i>SD</i>)		(<i>SD</i>)	(<i>SD</i>)		(<i>SD</i>)	(<i>SD</i>)
Autonomy support	1 – 7	.78	5.90	5.60	.94	4.48	6.59	.91	5.08	6.33
			(1.17)	(1.21)		(1.22)	(0.50)		(1.33)	(0.40)
Structure	1 – 7	.85	5.16	4.98	.84	5.21	5.68	.89	5.13	5.59
			(1.04)	(1.45)		(1.78)	(0.75)		(1.35)	(0.72)
Interpersonal involvement	1 – 7	.95	4.97	4.79	.92	5.04	5.66	.96	5.17	5.63
			(1.22)	(1.44)		(1.40)	(0.85)		(1.61)	(0.86)
Independent observers										
Autonomy support	1 – 7	-	4.50	5.13	-	2.75	5.63	-	2.25	5.88
			(1.41)	(0.88)		(0.71)	(0.18)		(0.35)	(0.18)
Structure	1 – 7	-	5.40	5.30	-	3.70	5.50	-	4.20	6.10
			(0.00)	(0.71)		(0.99)	(0.14)		(0.57)	(0.14)
Interpersonal involvement	1 – 7	-	4.88	4.75	-	3.13	5.63	-	3.25	5.63
			(0.88)	(0.35)		(0.18)	(0.18)		(0.00)	(0.88)
Active engagement	1 – 7	-	4.00	4.70	-	4.50	4.90	-	4.70	5.70
			(0.00)	(0.42)		(0.14)	(0.71)		(0.99)	(0.42)

Note: C = control group. SDTc = Self-determination theory-based condition. Cronbach alpha values could not be computed for the variables rated by the independent observers as there were only two observations per time point.

Table 2.

Reliability Analyses (Cronbach's Coefficient α) and Descriptive Statistics for Psychological Need Satisfaction, Motivational Regulations and Behavioural, Cognitive and Affective Outcomes at Weeks 1, 6 and 10, by Condition

			Week 1		Week 6			Week 10		
Variable			C	SDTc		C	SDTc		C	SDTc
	Range	α	<i>M</i>	<i>M</i>	α	<i>M</i>	<i>M</i>	α	<i>M</i>	<i>M</i>
			(<i>SD</i>)	(<i>SD</i>)		(<i>SD</i>)	(<i>SD</i>)		(<i>SD</i>)	(<i>SD</i>)
Psychological needs										
Autonomy	1 - 7	.72	5.56	4.85	.71	5.61	5.42	.61	5.59	5.39
			(1.28)	(1.44)		(1.16)	(1.07)		(1.35)	(1.06)
Relatedness	1 – 7	.91	5.11	4.60	.73	5.44	5.38	.93	5.40	5.72
			(1.27)	(1.51)		(1.07)	(0.79)		(1.28)	(0.84)
Competence	1 – 7	.85	4.54	3.80	.78	5.22	5.18	.75	5.33	5.61
			(1.30)	(1.44)		(1.23)	(0.90)		(1.08)	(0.69)
Motivational regulations										
Amotivation	0 - 4	.73	0.45	0.37	.57	0.13	0.27	.87	0.03	0.13
			(0.70)	(0.57)		(0.29)	(0.45)		(0.08)	(0.17)
External	0 – 4	.77	0.50	0.68	.81	0.35	0.70	.84	0.58	0.71
regulation			(0.66)	(0.85)		(0.39)	(0.90)		(0.98)	(0.83)
Introjected	0 – 4	.67	1.34	1.76	.69	1.61	2.04	.80	2.10	1.89
regulation			(0.91)	(0.78)		(0.75)	(1.03)		(1.03)	(1.00)
Identified	0 - 4	.68	3.15	2.75	.80	3.48	3.10	.82	3.30	3.13
regulation			(0.55)	(0.68)		(0.45)	(0.69)		(0.72)	(0.81)
Integrated	0 – 4	.66	2.49	2.21	.81	2.48	2.37	.92	2.87	2.38

regulation			(0.86)	(0.66)		(0.63)	(1.15)		(0.92)	(1.25)
Intrinsic	0 - 4	.83	3.25	2.78	.74	3.48	3.05	.92	3.38	3.04
motivation			(0.67)	(0.59)		(0.54)	(0.37)		(0.81)	(0.50)
Cognitive and affective outcomes										
Behavioural	1 - 7	.92	6.44	6.48	.67	6.33	6.47	.87	4.67	5.67
intention			(0.74)	(0.79)		(0.75)	(0.55)		(1.52)	(1.33)
Positive affect	1 - 5	.81	3.79	3.48	.90	3.88	3.59	.82	3.67	3.72
			(0.59)	(0.50)		(0.76)	(0.55)		(0.57)	(0.51)
Negative	1 - 5	.75	1.37	1.38	.83	1.21	1.17	.86	1.52	1.18
affect			(0.40)	(0.38)		(0.22)	(0.25)		(0.69)	(0.20)

Note: C = control group, SDTc = Self-determination theory-based condition. No α values are provided for total exercise as this is a single-item variable.